Management Utilization of Computers in American Local Governments

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Traditional concepts of management information systems (MIS) bear little relation to the information systems currently in use by top management in most US local governments. What exists is management-oriented computing, involving the use of relatively unsophisticated applications. Despite the unsophisticated nature of these systems, management use of computing is surprisingly common, but also varied in its extent among local governments. Management computing is most prevalent in those governments with professional management practices where top management is supportive of computing and tends to control computing decisions and where department users have less control over design and implementation activities. Finally, management computing clearly has impacts for top managers, mostly involving improvements in decision information.

Key Words and Phrases: computer utilization, management information system, American local government, city government computers, county government computers, computer impacts, management computing

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Introduction

With the continuing national shift of responsibility and resources for managing urban affairs to city and county governments, a large proportion of the future growth in local government computing is likely to be focused on generating management information. Management information systems (MIS) have long been an important topic among computer scientists, management scientists, and computing professionals concerned with the design and development of computerized information systems in business and government organizations. However, many of these discussions tend to be dominated by images of sophisticated applications, advanced technology, long-term potentials, or promotional arguments for particular ideal types of information systems. In contrast, little systematic empirical research addresses the actual state of the art, preconditions, and current impacts of computer use by top managers in American local governments.

This paper looks at MIS—what the literature says MIS are supposed to look like, what is supposed to make them happen, and what is supposed to result—and compares the theoretical paradigms with the reality of computing used by top managers in US cities and counties. Specifically, we describe two major conceptions of MIS and identify how "systems in use" differ from these ideal types. Given an understanding of the kind of MIS likely to be available to top managers in local governments, we can then examine the extent to which these managers use computer-based information. Since we find considerable variation in top management use, we next assess several theoretical perspectives which might explain the degree of management computing. These include the sophistication of computing, the values and attitudes of top managers, control over computing, and the organization's external environment. Finally, we assess the impacts from management computing. Here we utilize top managers' perceptions of benefits derived from computer-based information to evaluate the degree to which systems in use are supporting managerial activities.

More broadly, we examine management information systems as a special case of technological utilization in organizations. Our basic thesis, in line with other studies of technology in organizations [19, 25], is that computing utilization is a continuing social and political process in which the interests and values of various organizational elites predispose the use of computing and thereby affect those served by technology. We expect that top managers are chief among those whose values are served by computing and who benefit from its use.

This paper is based upon three sources of data. The first is a pretested nationwide census survey sent during the Spring of 1975 to the 403 US cities with populations of 50,000 or more and to the 310 counties with populations of 100,000 or more. The survey

consisted of two self-administered questionnaires: one mailed to the appointed or elected chief executives (mayors, city managers, county executives, board chairpersons, county administrators); another mailed to each data processing installation serving the city or county with the exception of private service bureaus. The survey obtained an 80 percent response rate for each questionnaire in municipalities and 70 percent in counties. The second data source used for the paper is US census data from cities and counties, and the third source is intensive field work in 40 US cities conducted during 1976.[1] The latter observational data is used to illustrate and clarify statistical findings.

1. The Shape of Computing for Management

The MIS literature suggests two ideal types of management information systems [18]. This section discusses those types and compares them with our findings regarding the basic pattern of information "systems in use" by top management in local government.

1.1 Alternative MIS Conceptions

Discussions of the use and provision of computer-based information for top managers are radically affected by two main theoretical conceptions of MIS: decision-based systems and data-based systems.[2]

The first and most traditional concept, the *decision-based system*, is largely tied to the theoretical and professional literature of management science, decision science, and operations research. This concept stems from management theories which posit decision making and "problem solving" as the essence of managerial activities and prescribe model building as a means for solving management problems [37]. Management information, then, is the output of formal analytical models and simulations. This type of management information is illustrated by the outputs of various planning and control models, e.g. an urban growth model for predicting economic, population, and land use trends, or a manpower allocation model for optimizing police beat assignments.

A computerized MIS based on the decision concept is the embodiment of model operations and the data flows required to support the models in the organization's computerized systems [1]. The data required to support various models are defined by the theory underlying each particular model and are distinctly different from operational data, given the decision notion. Therefore MIS must be built separate from the computer applications supporting routine government operations and have their own unique data collection procedures and supporting data flows [1, 13]. The computing technology underlying the decision-based system is that required for handling many small samples, sophisticated computations, and large simulations – namely, highly skilled specialized staff and large computational capacities.

The second ideal type, the *data-based system*, has its intellectual and practitioner heritage in the literature of computer science, information systems, and data processing. This concept of management information is supported by research that has found "problem finding"[3] to be an important managerial activity [32]. Management information is defined by extremely simple nonanalytical models, mainly involving data comparisons – over time, across organizational and geographic boundaries, and planned with actual achievements. These historical and areal models, which form the core of management information, are illustrated by the many routine reports, exceptions reports, and ad hoc comparison reports produced in the daily operations of most organizations.

From the data perspective, MIS is formed largely by integrating and reorganizing data from computer applications primarily serving routine government operations [6, 15]. The greater the degree and range of automation within the government, the broader the potential database from which management information can be generated. Achieving this potential requires the technical capacity for integrating data across departmental, agency, account, geographic, and other boundaries, storing large databases, and quickly accessing them for various information requests [26, 31]. The computing technology supporting MIS therefore includes highly skilled specialized staff, database management systems, large storage and core capacities, and online access.

1.2 Management Information Systems in Use

Our survey and field observations suggest that neither the decision-based nor the data-based paradigm characterizes most management information "systems in use" in local governments. First, top managements'[4] use of sophisticated analytic and simulation models, such as those in the decision paradigm, is extremely rare in local government.[5] The few experimental efforts in this direction have often had only one-time use and have been noticeably abandoned. For example, San Francisco's effort to use a complex computer-based simulation of the urban housing market was abandoned when it became clear that the data required for the model could not feasibly be kept current for continuous use, given the marginal benefit of its results [9, 35]. Second, the current level of staff skills and computing technology available in most local governments simply doesn't support database management, integrated databases, or the flexible online retrieval required by the data paradigm [17, 24]. Third, and elaborated next, the kind of "systems in use" by most local governments are best characterized as involving simple comparative information, derived from independent data files as a by-product of routine operational applications and produced on unsophisticated computing technology.

Table I. Comparisons of Ideal Types of Management Information Systems and Systems in Use.

Attribute	Ideal types: Decision-based	Ideal types: Data-based	Systems in use: Management oriented computing (MOC)
Activity served	problem solving	problem finding	problem finding
Model used	formal analytical models—mathematical or computer models	simple comparisons over time, across units, across geographical areas, planned with actual results	simple comparisons over time, across units, across geographical areas, planned with actual results
Data used	information generated *separately* from operations-oriented applications as data requirements defined by theory	information is a spin-off or by-product of operations-oriented applications, as data defined by available operational files	management use of operations reports, plus special purpose reports and information retrieval—financial and personnel emphasis
Sophistication of computing	sophisticated information storage and retrieval *not* a necessary condition	sophisticated information storage and retrieval, integrated data files and applications, database management, online access by managers	unsophisticated information storage and retrieval, independent data files and applications, file management systems, indirect access by managers
Examples	facility location models, financial forecasting models, cash flow models, urban development models, and simulations	land use/property inventory, integrated financial accounting, program oriented cost accounting	current balance reports, vendor reports, personnel listings

Our field observations indicate that the *kinds of computer-based information* used by local-government top managers generally take two major forms: regular reports from the departments and special reports in response to ad hoc requests by the manager and staff.[6] Where top management computer use is high, the managers and their staff tend to receive regular, routine computer-based reports on revenue collections, current budget balances, position vacancies, vendor payments, crime statistics, fire incident statistics, and so forth. The managers and their staff also tend to initiate ad hoc requests for special comparison reports, exception reports, and computer listings in connection with specific problems and concerns. Examples of these ad hoc requests include historical expenditure data, sick leave by department, affirmative action personnel listings by age, race, and sex of personnel, and census-based planning analyses of population and housing for selected areas of the city.

The fieldwork also indicates that generally the *sources* for nearly all of the computer-based information which top managers receive are the independent operations-oriented applications serving the departments. In some cases, regular management reports are designed as part of the application. In many other cases, however, management information is created by consolidating, sorting, listing, aggregating, or otherwise reorganizing the information from the many independent files for management uses. Finally, the *technology* used to produce this management information is frequently rudimentary. In most local governments, it consists of batch processing on medium-sized computers, generalized report programs, specially designed programs, and file management systems [17, 24]. Thus the management information "systems in use" by most local governments are the result of *a pragmatic approach towards orienting existing computer applications and computer technology designed primarily to serve the operations of the government to also generate information useful to management.* We call this "management-oriented computing" (MOC) to distinguish it from MIS and to signal its key feature—an orientation towards top management use of computing.

MOC distinguishes between unitary concepts of MIS and the reality of most local computing where multiple automated information systems each have an orientation towards management and each contributes to a "conceptual" database that can be tapped by top management. MIS as a monolithic entity appears to be rare, if existent at all, in local governments; there are pieces here and there, but apparently no unified system. As the foregoing suggests, MOC differs significantly from either the decision-based or data-based paradigm. The summary comparison in Table I shows that management-oriented computing contrasts with these paradigms in that:

(1) The conceptual models underlying management information are nonanalytic, informal, and incomplete rather than analytic, formal, or comprehensive.
(2) Management information consists of simple data arrays and comparisons rather than analytic results or "total information."
(3) The information is derived from independent operational files rather than formal model results or integrated databases.
(4) The technology supporting the systems in use is small computer, batch-oriented and involving simple file management, rather than sophisticated analytics on large computer memories or online retrieval supported by database management on large systems.

Overall, management-oriented computing clearly serves managerial "problem finding" more than "problem solving" activity and therefore is closer to the data-based concept. Nevertheless, it varies considerably from that ideal type.

Why don't the management information "systems in use" look like they should? A partial answer is provided by looking at the decision agenda and sophistication of computing in local governments. If one looks at the universe of decisions in most local governments, most decisions are minor rather than major

Table II. Chief Executive Perceptions about the Use of Computer-Generated Information.[a]

Question	Percentage indicating: Very often	Often	Occasionally	Seldom	Never
How often do departments provide computer-generated reports to you, the chief executive? (N = 509)	6	38	36	17	7
How often is computer-generated information utilized by your staff to prepare reports? (N = 509)	14	42	30	12	2

[a] City and county percentage differences are slight. Therefore the percentages for only the combined sample are shown to simplify the presentation.

ones. The opportunity for major decisions, where the decision-based MIS might contribute, are infrequent. In addition, many of these potential decision opportunities simply are foregone by local managers, as illustrated by the tendency towards incremental budgeting and manpower allocation in local governments [38, 40]. Of the major decisions that are taken, few involve clear sharp choices. In most, the relationships between the decisions and data are problematic; that is, the more significant the issue, the less likely it is that information generated by formal models will be relevant to the final choice [16]. Given the problematic relation of model data to these decisions and the infrequent requirement for use of the models, few top managers consider the time and money investments required by the decision-based MIS worthwhile. Therefore they are seldom built.

If one looks at the sophistication of computing in most local governments, it is immediately apparent that the technology required for data-based MIS rarely exists. Where it exists, the technology is often new and usually underdeveloped. And, since its development will be evolutionary rather than revolutionary, the results in most local governments will not look significantly different from MOC for a decade or longer.

In contrast to these situations, MOC is an adaptation to the decision agenda and available technology of many local governments. Most decisions made by top managers are *routine*, in the sense that they recur frequently, *incremental*, in the sense that they involve small changes from current conditions, and *remedial*, in the sense that the changes are movements away from some undesirable condition rather than movements towards some desired condition [8, 21, 38, 40]. These decisions are illustrated in local government practices regarding budgeting, taxation, manpower allocation, and social programs (e.g. the choice of service mix for recreation, libraries, or elder and youth programs). While managers could conceivably engage in "zero base" decision making regarding these areas and collect new information regarding each, they seldom do. Most decision making is incremental, involving small changes from current conditions. Since the decisions will recur with some frequency, further incremental movements can be made later if warranted. Therefore, in making these decisions, managers tend to use data which reflect *current* and *near past* conditions and *projections of the near past into the near future*. [8, 21]. These kinds of data are frequently found in the automated applications serving the operations of various local government agencies or derived therefrom. And, as one data processing manager put it, "Top managers who want computer reports will generally get them" regardless of the kind of MIS in the organization.

2. Management Use of Computing and Its Determinants

Given the unsophisticated nature of the management information systems in many local governments, one would expect top management use of computer-based information to be low. However, the fieldwork and our survey of US cities and counties indicate that *a large proportion of top managers use computer-generated information*, either directly or indirectly. Table II shows that 44 percent of the executives indicate they receive computer-generated reports from the departments "often" or "very often," and 56 percent of the executives indicate that their staff uses computer-generated information to prepare reports "often" or "very often." Since the staff assist the executive, their use of computer data is considered an indirect use by the executive.

Although management use of computing is common, considerable variability exists among local governments in the degree of computing use by top management. For example, while computer-based information is provided to executives "often" or "very often" in 44 percent of the governments, it is provided "seldom" or "never" in at least 25 percent of them (Table II). We think it is important, therefore, to examine whether there are systematic factors which account for the variation in computing use by top managers in local governments.

Our strategy for analysis is a correlational and multivariate design which treats management use of computing as the dependent variable and four classes of explanatory variables as predictors. The dependent variable, management use of computing, is an index which is constructed by summing the executives' re-

sponses to both items in Table II. The index simultaneously taps *management use of computing* and the *orientation of computing towards top management*. It measures the mix of information supplied to or demanded, and used, by top management. Thus it can be considered an indicator of both the degree of MOC and management use. Governments scoring high on the index tend to have relatively more use of computing by top management.[7] The predictor variables, which represent alternative streams of explanation for variations in management computing, are drawn from the literature on technological innovation and on computing in organizations. These are: (1) the sophistication of computing, (2) the values and attitudes of top managers, (3) the locus of control over computing, and (4) the organization's external environment. Each theoretical explanation is reviewed next and its relation to management computing is hypothesized.

2.1 Sophistication of Computing

A major thesis of the computing literature is that the value of an automated system to different members of an organization is dependent upon the technical state of computing development [27, 31]. This perspective suggests the *hypothesis that management use of computing is greatest in those governments with the most advanced computer technologies*. The hypothesis implies that the payoffs of computing for top management must await the development of a highly sophisticated, large-scale computing operation. To be of particular value to top managers, computing should be technically developed to a stage where there exists a sizable number of automated applications within the organization and a capability to integrate, retrieve, and restructure data gathered in day-to-day automated operations to generate management information.

Indicators of the sophistication of computing include measures of (1) *computer technology*, including operating system sophistication, total core capacity, and input-output sophistication and (2) *computer applications*, including data file integration, the range of processing capabilities, and the number of operational computer applications. Operating system sophistication is a rating scale which distinguishes batch systems from relatively more sophisticated systems handling online processing and multiprocessing with variable memory allocation schemes.[8] Total core capacity is the amount of core available on all of the central processing units used by the government.[9] Input-output sophistication is based on the kinds of peripheral devices used, generally distinguishing batch systems using card readers from online and batch systems with multiple modes of input and output available.[10] The data file integration index measures the extent to which data are, or can be, linked among different computer applications.[11] The range of processing capabilities is an index of the number of five different "information processing tasks" within which at least two applications are operational. Broadly, each type of information processing task requires more sophisticated computer technology (particularly software), and the resulting 0 to 5 point scale tends to approximate a cumulative scale pattern.[12] The total number of operational applications is a count of computer applications over all installations in the city or county.

2.2 Values and Attitudes of Top Managers

A second stream of literature suggests that the values and attitudes of top managers, like those of other organizational elites, can substantially affect the orientation of computing [14, 19, 34]. The values and attitudes of top managers may determine their propensity to shape the organization's automated information systems to serve management needs. Management values are reflected in the reform orientation of the government and top management support for computing.

The *reform orientation* of a local government reflects the values of top managers and may shape their propensity to orient computing towards their own needs. Some research indicates that computers are viewed by reformers as a tool for achieving their goals of improving the efficiency and rationality of government operations [19].

The urban reform movement is characterized by certain political-administrative structures (nonpartisan ballots, at-large elections, and council-manager forms of government) and professional management practices (such as management by objectives, program budgeting, performance measures). Modern managers who support these structures and practices also might be expected to push computing towards serving top management, as a technological mechanism to reinforce these other reforms, or as an alternative, to achieve the same reform goals of rationality and efficiency in government operations. The provision of computerized information might serve these goals by increasing centralized control over department operations and supporting greater rationality in management decision making. This perspective suggests the *hypothesis that management use of computing is greatest in those governments which have adopted reformed structures and professional management practices*.

Two measures are used to indicate each government's reform orientation. A structural index summarizes the presence of the following reform government structures: a city manager or county administrative officer, nonpartisan elections, and at-large elections.[13] An index of professional management practices indicates the proportion of government programs with written objectives and performance measures.[14]

Top management support for computing has been advocated in the practitioner literature [27, 28] and cited in research [33, 39] as a condition associated with the successful development of automated information systems. Those executives positively oriented

towards or supportive of computer development are more likely to take a personal interest in using the technology. Thus we *hypothesize that management use of computing will be greater in those governments where top managers have more supportive attitudes toward computing*. A summary scale of "top management support" is used to indicate the general attitude of the chief executive toward computing.[15]

2.3 Control over Computing

A third stream of literature posits a relationship between the locus of control over computing and whose interests the technology serves [12, 16, 19]. Broadly, the payoffs of computing for top management are likely to be dependent on top management's ability to control computing decisions and resources, particularly decisions to implement automated applications. This explanation suggests the *hypothesis that greater use of computer-based information by top management is found in those governments where top management controls computing*.

Two sets of variables are used to evaluate this hypothesis. The first set is composed of two measures of the locus of *control over computing decisions*. The top management control index reflects the degree to which top managers have a major role in computing decisions,[16] particularly those related to expansion of equipment or applications. The user control of design index indicates the degree to which department users participate in application design and implementation and thus influence the final product.[17]

The second set of indicators represent organizational structures which reflect *control over computing resources* and which might affect the degree of top management control over computing decisions. The number of in-house computer installations is a measure of the degree computing is decentralized within the government. A decentralized system might be more difficult for top managers to control. The presence of an independent computer installation under top management is another indicator of top management control. Such an installation is more likely to be more controlled by top management than one within an operating department, another government, or a service bureau.

2.4 Organization's External Environment

The fourth explanatory stream regarding the implementation of computing takes a system perspective which views government operations as being responsive to their external environment. Generally the environmental features that drive a government towards computer adoption and development might also be expected to affect the manner in which computing is implemented. The literature on computer utilization suggests that larger and growing communities seem to generate greater demands for computing owing to their increased size and complexity. Also, computer utilization is likely to be more prevalent in communities with higher socioeconomic status [5, 11]. The literature also supports the expectation that outside funding, particularly federal and state support, can affect the policy decisions of the local government organization. And, since much of the available state and federal financial support of computing emphasizes the use of computers for top managers, management computing might be enhanced by outside funding. Thus we *hypothesize that management use of computing will be greater in those governments with external environments supportive of computer utilization and in governments receiving outside funding for the support of computing*.

Four indicators of these environmental features relating to computer utilization are used here: total population in 1970, population growth from 1960–1970, a socioeconomic status scale, and the presence of outside funding.[18]

2.5 Determinants of Management Use

These foregoing hypotheses are initially evaluated on the basis of the statistical association of the independent variables and the management use of computing index. Table III records these correlations for cities, counties, and the combined sample. While our major concern focuses on general patterns common to both cities and counties, correlations within each sample aid in the identification of any systematic differences between cities and counties. Because our sample is large and approaches a census, it is particularly important to select those correlations which are not only statistically significant, but also theoretically significant. We chose statistically significant correlations greater than $\pm .10$ as sufficiently nonzero for further analysis.[19]

While the correlations identify variables which are associated with management use of computing, several important questions must be asked. To what degree is each variable *independently* associated with management use? What are the relationships among the independent variables related to management use of computing? How much of the variation across governments in management use is statistically associated with the entire set of independent variables? Answers to these questions are obtained by the exploratory use of path analysis. We have posited a model which systematically relates those variables from Table III that our findings suggest to be most central to explaining degrees of management use of computing in cities and counties. Path analysis results are displayed in Figure 1.

The most significant finding to emerge from Table III and Figure 1 is the generally weak association between management use of computing and each of the independent variables. Individually and collectively, the theoretical explanations account for a small proportion of the variation in management use of computing.[20] *While sophistication of computing, top management values, and control over computing deci-*

Table III. Correlations between Management Use of Computing and Hypothesized Independent Variables.

Categories and indicators	Cities and counties		Cities		Counties	
	r	*N*	*r*	*N*	*r*	N
A. *Sophistication of computing*						
Computer technology						
Operating system sophistication	.05	346	.01	215	.11	131
Total core capacity	−.02	344	.04	213	−.10	131
Input-output sophistication	.02	366	−.04	227	.10	139
Computer applications						
Data file integration	−.02	303	−.04	188	−.01	115
Range of processing capabilities	.11[a]	403	.11[a]	253	.10	115
Total number of operational applications	.14[b]	395	.10[a]	250	.19[b]	145
B. *Values and attitudes of top managers*						
Reform orientation						
Structural reform	.09[a]	512	.17[b]	306	.08	206
Professional management practices	.16[c]	504	.16[b]	303	.21[c]	201
Management attitudes						
Top management support for computing	.33[c]	512	.31[c]	306	.34[c]	206
C. *Control over computing*						
Control of computing decisions						
Top management control of computing expansion decisions	.24[c]	477	.22[c]	292	.30[c]	185
User control of application design	−.11[a]	320	−.20[b]	194	.01	126
Control of computing resources						
Number of in-house computer units	−.01	401	−.03	235	.01	148
Presence of independent computing unit under top management	.06	403	.01	257	.12	146
D. *Organization's external environment*						
Socio-economic environment						
Total population ($\log_{10}$)	.11	512	−.01	306	.06	206
Population growth	.08[a]	505	.14[b]	300	.12	205
Socio-economic status scale	.08[a]	503	.07	297	.08	206
External policy environment						
Presence of outside funding	.09[a]	351	.07	226	.10	125

[a] $P < .05$.
[b] $P < .01$.
[c] $P < .001$.

sions have marginal impacts on the use of management information, these impacts seem to represent a braking or accelerating effect rather than preconditions for management use of computing. Yet, some explanations appear relatively more important among these generally weak associations.

First, the *values and attitudes of top managers appear to be the variables most significantly associated* with management use of computing. Table III shows that top management support for computing is the most important predictor of management use, and Figure 1 shows that top management support both directly and indirectly relates to management control of computing decisions. Managers who are positive about computing tend to be in those governments with a greater use of computer-based information by top management.

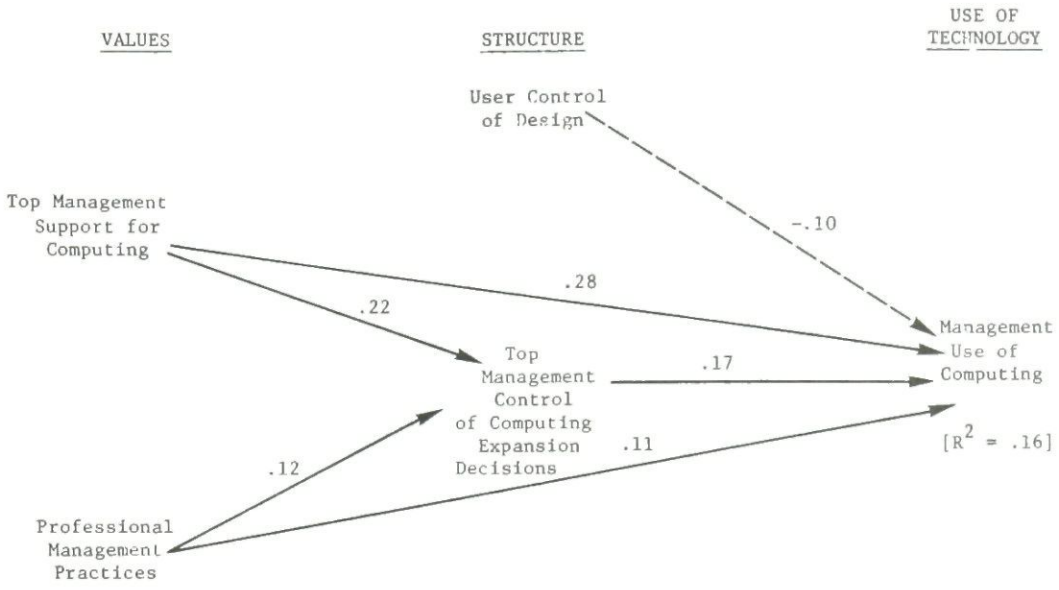
In addition, a reform orientation is related to management use of computing. Local governments which have adopted professional management practices have greater management use of computer-based information; cities, but not counties, which have adopted structural reforms also do (Table III). Further, professional management practices are both directly and indirectly associated with use through top management control of computing expansion decisions (Figure 1).

Second, *control over computing decisions, but not the control of computing resources, appears to be an important determinant of management computing.* In particular, decision structures which give department users greater control over application design and development are negatively associated with management computing, whereas those structures which provide top managers greater control are positively associated.

Table III shows that management use of computing is relatively higher where top managers have more control over computing expansion decisions and department users have less control over design decisions (in cities, but not in counties). But, neither hardware centralization nor the presence of an independent computer installation under top management, both measures of the top management control over computing resources, relates to greater management computing. In addition, Figure 1 shows that greater top management control of computing decisions tends to be more prevalent in governments with more professional management practices and greater top management support for computing.

Third, *the sophistication of computing is not significant in explaining management use of computing.* Table

Fig. 1. Path diagram of selected independent variables and management use of computing. "Path coefficients" displayed are standardized regression coefficients. Each arrow or path indicates a direct effect. All the direct path coefficients in bold lines are significant by the standard convention of being twice their standard error. Broken lines indicate negative coefficients. Arrows are deleted with coefficients less than that criterion.



III shows that all indicators of sophistication are both weakly and inconsistently related to management use of computing. While governments with a larger number of operational applications and a greater range of processing capabilities are somewhat more likely to generate management use, counties with greater core capacity are less likely to generate management use. Thus there seems to be no appreciably greater management use of computing in governments with higher levels of computing sophistication.

Finally, *the organization's external environment is not significant in explaining management use of computing.* While studies of computing innovation indicate that the adoption of computing and the extensiveness of automation relate to measures representing the social and economic environment, our findings suggest that how the technology is utilized and who it serves within the organization is relatively independent of the organization's external environment. Table III shows that only population growth is even weakly related to greater management use of computing among all of the socioeconomic indicators. The other major environmental indicator, presence of outside funding, fails to be related to management computing.

The weak associations of these independent variables and management computing tend to further endorse our concept of management-oriented computing. Computer-based management information does not appear dependent on large amounts of technical, monetary, or organizational resources being devoted to the development of sophisticated analytics or sophisticated government-wide integrated databases approaching either the decision-based or data-based systems. Thus the use of computer-based information by top management is likely to be dependent more on the personal awareness, imagination, and predispositions of top managers and staff, the computing staff, or both. For example, computing specialists who are aware of both top management's information needs and how currently automated applications can meet those needs might alone be enough to reorient computing to providing top management with computer-based information.[21]

3. Consequences of Management Use of Computing

Various theorists and practitioners have predicted that computer-based management information systems would have important direct and indirect[22] consequences for the quality of information for decision making, the efficiency of government operations, and the degree of administrative control exercised by top management. However, little systematic empirical research has been done on the consequences of current computer use by top managers. Given that current systems in use by local government top managers differ significantly from traditional concepts of management information systems, we might also expect the impact of current systems to vary from traditional predictions.

Here we present these traditional predictions and then explore the chief executive's perceptions of computer impacts on information for decision making, operational performance, and administrative control. Our strategy is to first assess the overall perceptions of the chief executives regarding the impacts of computers. We then use correlational analysis to determine the relationship between perceived impacts, as a dependent variable, and the degree of management computing, as an independent variable. Also, controls are introduced for the level of governmental use of computing[23] and the chief executive's support for computing in order to evaluate two alternative interpretations of any relationship between management computing and perceived impacts. First, the executive's perceptions, as those of other users, might be influenced by

Table IV. Chief Executive Perceptions about Computer Impacts.

Category and statement	Percentage indicating: Strongly agree	Agree	Undecided	Disagree	Strongly disagree
Decision making					
In general, computers provide information which is helpful to me in making decisions. (N = 562)	28	59	6	6	0
The computer makes information available to department heads that was not available before. (N = 562)	37	54	5	4	0
Reports and other materials produced by the computer are too detailed for my use.[a] (N = 561)	2	18	16	58	7
Operational performance					
For the most part, computers have not reduced the cost of government operations where they have been applied. (N = 563)	9	42	17	29	3
For the most part, computers have clearly increased the speed and ease of performance of government operations where they have been applied. (N = 565)	23	60	13	4	0
Computers usually enable a reduction in the staff necessary to perform a task. (N = 564)	4	28	25	39	5

[a] Disagreement with this statement indicates a positive view towards the impacts of computers.

their general attitude towards computing. Second, greater computer use in the government generally, regardless of its use by management, might result in the same impacts as greater management use.

3.1 Information for Decision Making

Theorists predicted early that computers would lead to improved management decisions [20, 37]. While research indicates that computers improve the technical qualities of information (accuracy, timeliness, and availability) throughout organizations, the research disagrees about the relevance of computer-generated information to managers since much of it is operations oriented (involving routine processing operations and record-keeping) rather than management oriented.[24] We expect that *managers will perceive beneficial computer impacts on the availability, relevance, and contribution of information for their decision making*. Also, these *impacts* are expected to be *more pronounced in governments with a greater degree of management computing*. Governments were rated as having more beneficial computer impacts on top management information for decision making where chief executives were more likely to agree that computers provide new information not previously available, provide information that is not too detailed for their use, and provide information that is helpful to them in making decisions.[25]

3.2 Operational Performance

Theorists have also predicted that computers would directly affect operational performance in organizations by reducing staff, increasing productivity, reducing costs, and increasing the speed and ease of work in various organizational tasks where computers are used [20, 36]. Research tends to support these predictions although the impacts have usually been considerably less than expected [7]. Other research indicates that in addition to these impacts from direct use of computers in various tasks, computing might indirectly affect operational performance by providing top management with information useful for identifying inefficiencies, problems, and needs for resource allocation [32]. We expect that *management computing provides managers with information for greater administrative control* and that therefore managers will think that *computers improve operational performance*. Again, we expect these perceived impacts to be accentuated in governments with a greater degree of management computing. Governments were rated high on operational performance impacts if the chief executives were more likely to agree that computers have reduced costs, reduced staff size, and increased the speed and ease of performance of that government's operations.[26]

3.3 Administrative Control

The early theorists also predicted that computers would extend superiors' control over the decision processes and performance of subordinates by quantifying more output information and making it readily available. Generally the research indicates that computers result in greater control by superiors over subordinates at all levels of the organization, but particularly at the lower levels between supervisors and clerks [41]. Other research indicates that the control information available to top managers is mainly information that has been aggregated from lower levels of the hierarchy [3, 29, 42]. Thus we expect that *management use of computing will increase administrative control of supervisors over staff on their organization*. Governments were rated high on perceived control if the chief executives agreed that computers increase the control of superiors over subordinates in their organizations.[27]

3.4 Management Use and Perceived Computer Impacts

The findings (Tables IV and V) indicate that local

government chief executives clearly perceive decision-making benefits from computing use but are less certain about operational performance and administrative control benefits. Further, the perceived decision-making benefits tend to be greater in governments with greater management use of computing (Table VI).

Local government chief executives clearly think that computers improve the quality, quantity, and usefulness of management information (Table IV). More than 90 percent of the executives agree that computers have increased the amount of information available. Nearly the same proportion finds that such information has been helpful in decision making. Further, although most computer applications currently serving them appear designed primarily for routine operations rather than for management, two-thirds of the executives believe that the computer reports they receive are not too detailed for their use.

Operational performance benefits are not as uniformly perceived as are information benefits (Table IV). Only about half (51 percent) of the executives perceive cost reductions. Only about one-third (32 percent) perceive staff reductions. The only widely perceived (83 percent) operational benefit is "increased speed and ease of performance." Also, few chief executives (28 percent) perceive the computer as increasing administrative control (Table V). Most executives (70 percent) see no impact of computers on the control of supervisors over staff; a very few (2 percent) feel there is decreased control.

Table VI shows that chief executives in governments with greater management use of computing are more likely to perceive beneficial impacts on decision making and, to a lesser extent, on operational performance and administrative control. These relationships are weakened when controlling for the degree of chief executive support for computing—slightly for decision and control and considerably for performance impacts. The relationships are virtually unaffected when controlling for the overall degree of computing utilization in the government.

This analysis indicates that executives derive decision-making benefits from computing, and the greater the degree of management-oriented computing, the greater the perceived benefits. Much of the practitioner literature on management information systems emphasizes decision-making benefits [23], and these may well be the most salient benefits from computing for executives. The following comments of one chief executive suggest that this is the case; they further indicate that the kind of data the executives consider valuable is related to our characterization of management-oriented computing:

"Perhaps the greatest overall benefit of EDP to management is the ease of *accumulation of functional cost and production data* and its availability for assisting in decisions on how best to use the city's resources . . . .

The more involved an organization becomes in computerizing its processes, the greater are the opportunities for better decision making. The *availability of masses of data when needed*, because of the *practicality of accumulating data* and because it can be *accessible in usable form*, provides a wide range of decision-making opportunities not available previously [32]." (Emphasis added.)

Table V. Chief Executive Beliefs about the Impact of Computers on the Supervision of Subordinates.

"Has the use of computers and data processing significantly altered the relationship between supervisors and staff in departments which use them?"	Percent indicating	N
No	70	338
Yes, tended to give supervisors *more* control over staff	28	136
Yes, tended to give supervisors *less* control over staff	2	10
Total	100	484

4. Discussion

The evidence presented in this paper indicates that current MIS paradigms bear little relation to the systems actually in use in most local governments. While the decision-based and data-based paradigms are theoretically valid and, indeed, useful alternatives for thinking about MIS, they appear to be inadequate guides to building MIS. That is, not only is MIS often more complex than it seems, but also MIS concepts fail to adequately consider the realities of local decision making, the state of computing technology, and the importance of interpersonal relations between top management and data processing professionals. It may behoove computer professionals to pay more attention to local constraints in order to increase the utility of computer-based information systems for top management.

This paper also indicates that "problem finding" characterizes the predominant way automated information systems currently are used in most local governments. While this doesn't deprecate the potential value of decision-based MIS, it suggests that the current utility of the paradigm is limited by the decision agenda and tendency towards incremental decision making in most local governments. These findings suggest that the data-based MIS might characterize local governments more highly over the long term, while MOC will continue to characterize them in the short term. Perhaps, when large urban databases are available, local governments might use the decision-based MIS concept more effectively, both to develop a better understanding of urban phenomena so as to build formal models and to provide current data to operate such models on a continuous basis [11, 17].

Despite the unsophisticated nature of management-oriented computing, top management use of computing is surprisingly common in most local governments, but management use varies in extent among local govern-

Table VI. Correlations between management use of computing and hypothesized effects, with controls for chief executive support for computing and for governmental computing utilization.[a]

Indicators of impact	Zero-order correlation		Partial controlling for chief executive support		Partial controlling for governmental computing utilization	
	r	N	r	N	r	N
Decision making	.35[c]	510	.24[c]	482	.36[c]	388
Operational performance	.24[c]	512	.09[b]	482	.20[c]	388
Administrative control	.24[c]	486	.15[c]	482	.19[c]	388

[a] Correlations within the city and county samples closely approximate those of the combined sample. Therefore only correlations for the combined sample are shown to simplify the presentation.
[b] $P < .05$.
[c] $P < .001$.

ments and further varies in perceived impacts among local executives. Management use of computing is most prevalent in those governments with professional management practices, where top management tends to control computing decisions, and department users have less control over design and implementation activities. Environments with highly sophisticated computer technology or applications are not more likely to generate greater management computing. Also, neither the formal organizational structure of computing services nor the organization's external environment appears to constrain or promote management use of computing.

Management computing clearly has impacts for top managers in local governments; the impacts are real and generally beneficial, but they are complex too. The benefits for managers are not simply that they are provided with more and better information faster. The benefits evolve from the complex interactions between top management and computing professionals, wherein existing operations-based information is brought to bear on the manager's decision problems, with each interaction producing small marginal benefits to the final decisions. Taken together, however, these many small benefits can make a substantial difference. The chief executives' perceptions indicate that they do make a difference – at least to the executives.

Greater management information benefits probably can be achieved in most local governments without expansion of their current computing technology. Such benefits are often used by vendors and computing managers to sell more advanced technology to local government managers, yet this study indicates that the sophistication of computing bears little on management use of computing or the perceived benefits from greater management use. It may be that no relationship emerges because too few local governments approach the level of sophistication in technology that would significantly impact the availability and use of information by managers. However, it also may be that management values and [illegible] portant as technology, if not more so, in contributing to management computing.

Finally, greater management use of computing is likely to place increased demands on computing professionals for communications skills and working knowledge of the management function in organizations. Management computing currently tends to generate frequent irregular demands for exception reports, comparison reports, and various rankings or listings. These demands may be expected to become more complex in the future. Satisfactory handling of these demands is likely to require that computing professionals (1) communicate effectively with top managers to advise them of available data and potential forms of reporting, as well as to help identify their information needs, and (2) develop the capacity to anticipate needs and how various data sources might be used effectively by managers. Few computing managers in local government enjoy frequent direct communication with top management even in places where communication with department users is frequent and direct. Since there is little likelihood that this will change, given the multiple demands on top managers' time, computing professionals need highly developed communication skills to make effective use of the limited time available. A corequisite to communication, however, is greater knowledge of the management function in organizations so that computing professionals can act as "surrogate managers" and anticipate top management's needs.[28]

Notes

1. These 40 sites are *not necessarily* the most sophisticated MIS sites. However, at least some of the 40 sites are among the most sophisticated cities in the US. The 40 cities were selected through a two-stage sampling strategy which stratifies cities on six major policies of interest to our research. These policy variables are the degree of automation, sophistication of computing, degree of integration, user involvement in design, decentralization of computing, and charging for computing services. The sampling strategy is designed to assure an adequate distribution of our 40 cases on the six policy variables and to assure some independence among the policies so that each research site approaches a unique mix of the six computing policies.

2. These two phrases are deliberately chosen to indicate the fundamental difference in approach of the decision and data paradigms. One assumes that managers face predictable decision problems and therefore need collect only the data relevant to those problems. The other assumes that managers face a general set of potential problems and therefore collect data relevant to the set to increase the probability that the relevant data will be available when one problem in the set becomes operative.

Put another way, the decision concept assumes that most management problems are recurring and standard, that managers know their problems and alternative solutions, and that the chief task is to choose the best solution. Management information systems are to inform them of choices among alternative solutions, and the data are collected only when a decision is at hand. In contrast, the data concept assumes that most management problems are recurring but nonstandard, that managers know the general set of problems that recur and reasonable solutions but not their specifics, and that the chief task is scanning the environment to discern "what is the problem." Management information systems are to inform them of choices among alternative definitions of the problem. Because the problems and potential definitions are many and varied, a relatively large database relevant to the set of problems is collected in advance and maintained to increase the probability that it will be available when needed.

3. According to Pounds [32], "problem finding" is associated with identifying differences between an existing situation and some desired situations, whereas "problem solving" is the process of selecting operators that will reduce such differences.

4. Top management is defined conventionally here as the chief executive and the staff serving the executive. In cities, this usually consists of the mayor and staff, or the city manager and staff, or both. In counties, it consists of the chairman of the board and staff, or the county executive and staff, or both.

5. For example, our survey indicates that urban development models (population, housing, land use, or economic models) are operational in only 30 cities and counties, and revenue forecasting models are operational in only 80 cities and counties from a total of 713 governments. Pack [30] reports that the continued maintenance and use of urban models, once developed, is low.

6. Several detailed analyses of local decision making [10, 38] also point out the reliance of decision makers on simple unsophisticated information and analysis. Dependence on comparisons of last year's budget with current requests is a recent example from the decision-making literature which suggests that the usefulness of information is not necessarily a function of sophisticated analysis.

7. Both items are combined into a single index because they have face validity as a single measure and are highly associated. Index scores represent the average value of all nonmissing responses. The interitem correlation between the two items is significant at the .01 level and equals .48 for the combined city and county sample.

8. Central processing units at each installation were classified as: 1 = glorified adding machine; 2 = batch only; 3 = batch only, multiprogramming, no communication capability; 4 = 2 or 3 plus online; 5 = online, multiprogramming, fixed task, possible spooling; 6 = online, multiprogramming, with nonfixed memory allocations schemes; 7 = online, multiprogramming, variable task size. The index was given a weighted average in governments with more than one installation through weighting by core capability.

9. Total core capacity is measured in bytes. This measure is frequently unavailable in the database for those governments that use private service bureaus.

10. This is an additive index which sums the following: 1 point if card reader, keypunch, or card punch is used; plus 2 points for magnetic ink character reader, optical character scanner, key-to-tape, or key-to-disk; plus 1 point for plotter; plus 5 points for cathode ray tube terminal (CRT) or remote timesharing typewriter terminal, plus 1 point for a graphics terminal.

11. This index is the standardized sum of: (1) the level of database management technology, scored 4 = recognized DBMS use, 3 = homemade DBMS or recognized file management system used, 0 = no DBMS used; and (2) the number of data files shared by two or more departments.

12. Each of the 250 computer applications investigated in the data processing manager questionnaire was categorized by its primary modality of use as one of five information processing tasks. The five tasks, arranged by the frequency with which they occur, are record-keeping, calculating/printing, record restructuring, sophisticated analytics, and process control. Each government was then scored by the number of different tasks in which two or more applications were operational. This resulted in the 0 to 5 point scale for range of processing capabilities. Measures of fit for the scale components relative to an ideal cumulative pattern are: coefficient of reproducibility, .93; minimum marginal reproducibility, .76; coefficient of scalability, .71.

13. The index is the average of the following three facets: (1) chief administrative score, coded 1 = manager or county CAO, .3 = city CAO, 0 = no chief administrative officer; (2) partisanship score, coded 1 = nonpartisan, .3 = only local parties, 0 = partisan; (3) election district score, coded 1 = at-large, .5 = mixed, 0 = ward or district.

14. Executives were asked: "Do departments and agencies within your local government establish written objectives for the programs and services they provide?—no; yes, for some programs; yes, for nearly all programs." "Does the chief executive see measures of performance in meeting the objectives of these programs?—no; yes, for a few programs; yes, for about half; yes, for most of the programs; yes, for all of the programs."

15. The top management support scale is the summed score of each chief executive on each item below; high scores on the index represent high levels of support. Cronbach's alpha for the index equals .65. This scale sums the standard scores of chief executives' responses to the following items, rated from strongly agree to strongly disagree: (1) "The computer is an essential tool in the day-to-day operations of this government." (2) "In the future, the computer will become much more essential in the day-to-day operations of this government." (3) "Computing and data processing have generally failed to live up to my original expectations." (reversed) (4) "In the future, a larger proportion of this local government's budget should support computers and data processing." (5) "I have indicated to department heads that computers and data processing should be used wherever economically feasible in this government."

16. The top management control index represents the number of the following criteria which were met: (1) Executive "strongly agrees" that "Decisions about the expansion of data processing facilities and services are generally made by the chief executive, although others may initiate the request." (2) In governments with an EDP policy board, recommendations of the board are made to the chief appointed official. (3) In governments with an EDP policy board, the chief executive's office is represented on the board. (4) Executives believe it is "extremely likely" that the chief appointed official and staff will have a major input in a decision related to data processing, such as introducing computers to help perform a task. The number of criteria met was further divided by the number of criteria applicable to that government.

17. The user control index is coded: 0 = users have not programmed or designed applications within the last two years; 1 = have programmed or designed applications; 2 = have both programmed and designed applications within the last two years.

18. The measure of population is the logarithm of total population in 1970 to the base 10. The measure of population growth rate is the percentage change in total population between 1960 and 1970. The socio-economic status scale is the sum of the following standardized variables: percent employed in managerial and professional positions; percent of families with incomes over $25,000; median school years completed; and percent of persons 21 years and over who have completed four or more years of college. The presence of outside funding is a dummy variable, coded 0 or 1 to indicate the absence or presence of outside funding. This includes federal or state sources and includes the direct application of federal revenue-sharing monies. The level of outside support over a three to five year period would be a more satisfactory measure but is not available. Absolute amounts were not used because they were deemed to be unreliable.

19. Specifically, the variables professional management practices, support of computing, top management control of computing expansion, and user control of application design meet his criterion and are included in Figure 1.

20. Only 16 percent of the variance in management use of computing is accounted for by the four major independent variables included in Figure 1. Only 19 percent of the variance is accounted for by considering additional variables from Table III which have a statistically significant relationship controlling for all other variables. That is, stepwise regression analysis using all variables of Table III with an F level greater than 1.0 accounts for about 19 percent of the variance in management use of computing within the city and county sample.

21. Our field observations indicate that this occurs now in sites with greater management computing, but through very indirect processes. Basically, it occurs because large resources are required to design and develop computerized systems, and therefore systems must be developed with the active support or at least the consent of top managers who can mobilize the resources. In securing top management support, computing specialists frequently lead top managers to expect personal impacts from computing—mainly involving information related to the managers' concerns. Although the large-volume information processing activities of the government keep the computer specialists oriented toward routine operational automation, the "expectations" they have created place a continuing pressure on the computing staff to deliver information benefits, however small, to top managers along with operational automation. The greater the computer specialists' understanding of "management," the more likely they are to be able to generate relevant information and increase top management use of computing.

22. While the computer's impact on information used in decision making, on operational performance, and on administrative control might be direct and immediate, it also might be indirect. Specifically, the computer's impact on operational performance and administrative control might operate indirectly through the provision of infor-

mation that allows top managers to effect improvements in operational performance and to better control the behavior of subordinates.

23. The computing utilization scale is the average of the following standardized variables: number of years (prior to 1975) that computing services have been utilized; the proportion of budgetary resources devoted to computing; computing expenditures per capita; the number of computer applications operational; and the number of four different types of "information processing tasks" within which at least two applications are operational.

24. Adam's [2] findings on the technical qualities of information agree with other research but disagree with Lucas [22] and Ackoff [1] regarding the management relevance of much computer-generated information.

25. Average summed score for executives' responses to the information benefit items of Table IV. Each is coded: 1 = strongly disagree to 5 = strongly agree, with the third item reversed.

26. Average summed score for executives' responses to the operational benefits of Table IV. Coded: 1 = strongly disagree to 5 = strongly agree.

27. Executive's responses to question: "Has the use of computers and data processing significantly altered the relationship between supervisors and staff in the departments which use them?" Coded: 1 = tended to give supervisors less control, 2 = no, 3 = tended to give supervisors more control.

28. In smaller installations, this will become an additional capacity required of the computing manager. However, larger installations probably will need to employ computing professionals educated along the lines of the ACM Curriculum Committee's recommendations for "Management Education in Computing" [4] and assigned to developing the organization's management system.

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